

Pleonandrae which I have mentioned, but it is necessary to collect from the same plant at different times, because only well-collected material will be sufficient to make more definite statements possible. Besides this it is very important that the collector make notes with regard to the habitat, the habit, the associated species of *Salix*, and whether the branchlets are more or less brittle or tough at the joint. The last character seems to be of great taxonomic value for the separation of the tough-jointed *Bonplandiana* from the very brittle-jointed *Nigrae* and the (more or less) brittle-jointed *Lucidae* and *Amygdalinae*.

A PHYTOGEOGRAPHICAL SKETCH OF THE LIGNEOUS FLORA OF KOREA

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KOREA, or Chosen, as it is now designated by the Japanese, is a peninsula bounded on the east by the Japan Sea, on the south and west by the Yellow Sea, and on the north by Manchuria and the Primorsk province of eastern Siberia from which it is separated by the Yalu River, Paiktu mountains and the Tumen River. Until quite recently it was styled the "Hermit Kingdom" by peoples of western lands and it had little or no intercourse with the outside world. The whole peninsula (including adjacent islands) is confined within Lat. $33^{\circ} 12'$ and $43^{\circ} 02'$ N. and Long. $124^{\circ} 13'$ and $130^{\circ} 54'$ E. and has a total area of 84,173 square miles (English). Geologically speaking nearly four-fifths of Korea is of granites and highly metamorphosed rocks of Pre-Cambrian age. In the central parts between Lat. 38° and 40° N. and stretching almost from sea to sea is an area of Paleozoic rocks, chiefly mud-shales, slates, and a little limestone; in the southeast is an area of Mesozoic limestones with intrusive porphyritic rocks and isolated outcroppings of this combination of rocks obtrudes itself in other parts of Korea. Basalt underlies much of the peninsula and in the volcanic areas — Paiktu mountains, highlands south of Gensan, the islands of Quelpaert (Sai-shu-to) and Dagelet (Ooryöngtō) — it has been forced to the surface and is surmounted by trachyte lavas. Each of these geological formations has certain plants peculiar to it. For example, Larch (*Larix dahurica* var. *Principis-Rupprechtii* Rehd. & Wils.) grows only on the recent volcanic soils of the Paiktu region and there forms vast forests; a Birch (*Betula Schmidtii* Regel), one of the most valuable of Korean hardwood trees, is confined to the granites and metamorphic rocks; a Lilac (*Syringa dilatata* Nakai) is found only on the paleozoic rocks of north-central Korea. The climate is the best in the Far East and the country is destined to become the health resort of the Orient. It is essentially continental in character but in the extreme south and east-southeast, near the coast it is moderated by the influence of the Japan current — a warm ocean stream similar to our Gulf Stream. On Quelpaert Camphor and Orange trees grow at sea-level and the temperature there seldom falls below the freezing-point; in the

extreme north in the valleys of the Yalu and Tumen rivers it falls as low as twenty below zero Fahrenheit — that is 52° F. of frost; round Keijyo or Seoul, the capital of Korea, the rivers freeze solid or nearly so and in winter all vehicular traffic crosses the ice where bridges are not available.

Korea is a very mountainous country; there are no plateaus nor plains worthy of the name and the only flat land is confined to narrow valleys and estuaries of the rivers. The mean height of the broken country is from 300 to 600 m. and that of the mountains from 1000 to 1800 m.; the highest peak is Paiktu-san 2700 m. but there are many about 2000 m. high. Agriculture is the staple industry of the people and the whole of the most fertile soils in the most accessible and climatically best parts of the country have been brought under cultivation. Since the winters are very cold much fuel is necessary and unfortunately coal is found in one or two places only and the people are almost entirely dependent upon wood for fuel. These two facts, and more especially the absence of coal, have been mainly responsible for the disappearance of the forests from the greater part of the peninsula. It is true that in the extreme north, which is very difficult of access and the population very sparse, magnificent forests of great extent remain and on mountains, like the Diamond Mts. where Buddhist monks have managed to maintain their influence and round royal tombs the vegetation has been very little disturbed, but over fully two-thirds of the whole country the forests have been destroyed and where no cultivation is to-day attempted coarse grasses, shrubs and scrub Pine are all that remain. These constitute the chief fuel supply of the country. The scrub Pine is *Pinus densiflora* S. & Z. and this has been extensively planted both under the old Korean régime and by the present Japanese government and to the casual observer appears to be almost the only tree in the country. It is hacked and maimed annually to supply fuel yet it manages to maintain itself under the most adverse conditions, in the poorest of soils and on the barest of rocks; where left alone it develops into tall, handsome trees. From the railway which traverses the country from southeast to northwest the impression left on the minds of nearly all travellers is of treeless, scrub and grass clad hills, bare rocks, low scrub Pine scattered over mountain-slopes with patches of cultivation in the valleys. In winter when the crops are harvested and the grass is shorn and brown, the whole countryside looks cold, drab and cheerless. However, a more intimate acquaintance, a closer study, will show that, in spite of the naked appearance in winter and the marked absence of trees from accessible areas and routes, Korea can really boast a fairly extensive flora comparatively rich in trees, shrubs, and in herbs having conspicuous and beautiful flowers. Compared with that of its neighbours, China and Japan, the flora of Korea is much less rich and varied, yet in individuals of striking merit it has many claims, and these none the less strong for remaining virtually unknown until quite recently. For, although small collections have been made from time to time since 1854, when Baron Alexander Schlippenbach gathered the first plants in Korea, no real investigation of the flora had been undertaken prior to the country's annexation

by Japan in 1910. Since that date the Government-General has systematically undertaken an investigation of the natural resources of Korea and the botanical work is in the hands of Dr. T. Nakai. So far 2,822 species, varieties and forms, belonging to 780 genera, representing 151 families, have been recorded, but the work is by no means completed. About one-fourth of these are woody. Most of the families which occur in Japan, north China and northeast Asia are present but often much reduced in number of representatives. For example:— the family of *Magnoliaceae* is represented by two genera (*Magnolia*, *Schisandra*) with three species. The most prominent family that is missing is *Hamamelidaceae*. A genus that one might expect to be present and which is not is *Cercidiphyllum*.

Now whilst the seas are natural phytogeographical barriers the political boundaries of Korea, — i.e. the Yalu and Tumen rivers and the Paiktu mountains — are not and the flora is essentially part of that of the great region of northeast Asia including Manchuria and the northernmost parts of China proper as far west as Mt. Wutai in Shansi province. Of woody plants at least one genus (*Pentactina*) and a limited number of species (*Viburnum Carlesii* Hemsl., *Cornus officinalis* S. & Z., *Forsythia ovata* Nakai and a few others) are endemic, quite a number such as *Abies holophylla* Maxim., *Rhododendron Schlippenbachii* Maxim. do not cross the Yalu watershed to the plains of Manchuria, but the majority are widespread on the continent of northeast Asia and many cross to Hokkaido and to northern Hondo in Japan proper. Of the latter mention may be made of *Alnus japonica* S. & Z., *Rhododendron brachycarpum* G. Don, *Styrax obassia* S. & Z. Further, a few species, including five (*Quercus glandulifera* Bl., *Q. aliena* Bl., *Q. dentata* Thunb., *Q. serrata* Thunb., *Q. variabilis* Bl.) of the six species of deciduous leafed Oaks, are widely distributed in China and Japan. The two volcanic islands, Quelpaert off the extreme south, and Dagelet off the east coast, in the Japan Sea, are peculiar. The first-named, with its peak, Hallai-san, 1952 m. high, has largely a Japanese flora, and is marked by the presence of broad-leaf evergreens in great variety. A few species, for example, *Maackia Fauriei* Nakai, are possibly endemic and pure woods of Hornbeam (*Carpinus laxiflora* Bl. and *C. Tschonoskii* Maxim.), with *Daphniphyllum macropodum* Miq. and *Taxus cuspidata* S. & Z. as conspicuous undergrowths are a characteristic feature between 1000 m. and 1300 m. Such woods are unique in the Orient. The trifoliolate Orange (*Poncirus trifoliata* Raf.) is indigenous, growing in the beds of torrents or among boulders; nowhere else in my travels have I seen this plant truly wild. No species of *Spiraea*, *Deutzia* nor *Philadelphus* grows on Quelpaert, yet they are common shrubs on the mainland. On the other hand, *Hydrangea petiolaris* S. & Z., *Schizophragma hydrangeoides* S. & Z. and *Ostrya japonica* Sarg., unknown on the mainland, are common on this island. Two other very common plants are *Rhododendron Weyrichii* Maxim. and *R. poukhanense* Lév.; the first named does not grow elsewhere in Korea whereas the latter is widely spread through the peninsula. Such typical Japanese trees as *Pinus Thunbergii* Parl., *Torreya nucifera* S. & Z., *Myrica rubra* S. & Z. and *Machilus Thunbergii*

S. & Z., *Magnolia kobus* DC. are indigenous in Quelpaert but grow nowhere else in Korea. The Fir on the island is an undescribed species, similar in habit to *Abies Veitchii* Lindl., has cones like *A. sachalinensis* Mast., but less resinous, and bark like that of *A. nephrolepis* Maxim. It just crosses to the mainland but finds its northern range on Chiri-san about Lat. 35° N. The Chiri range is interesting phytogeographically since it is the southern limit of such characteristic Korean plants as *Rhododendron Schlippenbachii* Maxim., *Pinus koraiensis* S. & Z., *Abies holophylla* Maxim., *A. nephrolepis* and the widely spread *Picea jezoënsis* Carr. and *Alnus hirsuta* var. *sibirica* Schneid.; also it is the only region in Korea where grow *Stewartia pseudocamellia* Maxim. and *Rhododendron Tschonoskii* Maxim., two typical Japanese plants.

The flora of Dagelet Island is most singular, being much more closely related to that of Japan than to that of Korea. The Japanese *Pinus parviflora* S. & Z. and Hemlock, *Tsuga Sieboldii* Carr., find their western limits on this island and woods of a Beech (*Fagus multinervis* Nakai), considered endemic, are a feature of the forests high up on the mountains. No Beech grows on the mainland of eastern Asia nor in China until the province of Hupeh is reached. Among other endemic species worthy of mention are *Acer Okamotoi* Nakai, *Abelia coreana* Nakai, *Sambucus pendula* Nakai, *Cotoneaster Wilsonii* Nakai. The Keaki, *Zelkova serrata* Mak., common to Japan and Korea is also indigenous on Dagelet Island and so, too, is *Pinus densiflora* S. & Z. The Chinese Juniper (*Juniperus chinensis* L.) is wild on the sea cliffs and has huge trunks though the trees are not tall. The lovely *Viburnum Carlesii* Hemsl., a littoral species, also is indigenous, but has so far not been found on the contiguous east coast of Korea although it grows in one or two localities on the west coast and on Quelpaert. These two insular outposts of the Japanese flora are the more remarkable when it is remembered that although both are volcanic their basalt and trachyte lavas prove that they belong to the Korean and not to the Japanese system of volcanoes.

Omitting the foregoing anomalies the flora of Korea is specifically and markedly different from that of Japan and China. Yet though species are limited, genera are well represented, and the small size of the country, its severe climate, and the destruction wrought during centuries of deforestation duly considered, it compares not unfavorably with that of contiguous and adjacent regions of the same latitudes. The whole flora of the Korean peninsula is essentially boreal in character and its outstanding feature is the almost complete absence of broad-leaf evergreens. Of these fifteen species, *Zanthoxylum alatum* var. *planispinum* Rehd. & Wils., *Ilex cornuta* Lindl., *Evonymus radicans* Sieb., *Buxus microphylla* var. *koreana* Nakai, *Rhododendron brachycarpum* G. Don, *R. micranthum* Turcz., *R. chrysanthum* Pall., *R. parvifolium* Adams, *R. confertissimum* Nakai, *R. Redowskianum* Maxim., *Ledum palustre* L., *Vaccinium Vitis-idaea* L., *Phyllodoce coerulea* Bab., *Empetrum nigrum* L. and *Sasa spiculosa* Mak. only are found there. The first six are confined to central and southern Korea, the Sasa, although

widespread, is nowhere very abundant, the others are alpine plants and grow only in central and northern Korea. Except the social, alpine plants and the *Sasa* these broad-leaf evergreens are local in their distribution, few in numbers and nowhere a conspicuous feature of Korean vegetation. Mistletoe both with a greenish white and reddish fruit is a pest everywhere.

The deciduous broad-leaf trees which compose the woods and forests belong to familiar northern genera and include several species each of Willow, Alder, Birch, Poplar, Hornbeam, Elm, Oak, Maple, Cornel, Nettle Trees, and one or two each of Cherry, Bird Cherry, Crab Apple, Wild Pear, Ash, Walnut, Sweet Chestnut, Spiny Elm, Honey Locust, Linden, Apricot, Sophora, Koelreuteria, Phellodendron and the Keaki. The woods and forests of these trees are left on steep, rocky mountains unsuited to agriculture and where the soil is poor, so they are not large when compared with their congeners in America, Europe or Japan. Occasionally, when for religious or sentimental reasons groups of trees or individuals have been allowed to remain in valleys and by roadsides, good specimens may be seen, but in general Korean broad-leaf trees are small and their timber of less value than that of the same species from Manchuria or Hokkaido. The largest of these Korean trees is *Populus Maximowiczii* Henry which in the sparsely peopled north is often 100 ft. tall with a trunk 20 ft. in girth. A Black Ash (*Fraxinus mandshurica* Rupr.) ranks next but I have seen in Hokkaido far larger trees of this species, and logs rafted down the Yalu from its Manchurian tributary show that in Manchuria it is also a larger tree. The Mongolian Oak (*Quercus mongolica* Fisch.) probably ranks third in size but on a part of the Diamond Mts. only did I see any really noteworthy examples of this Oak. The most widely distributed trees are *Quercus mongolica* Fisch., *Betula Ermanii* Cham., and *Prunus serrulata* var. *pubescens* Wils. which are common from Quelpaert to the Manchurian border and northward. Almost as common are *Alnus hirsuta* var. *sibirica* Schneid., *Populus tremula* var. *Davidiana* Schneid., *Betula davurica* Pall., *B. japonica* Sieb., *Quercus dentata* Thunb., *Phellodendron amurense* Rupr., *Ulmus japonica* Sarg., *Acer pictum* Thunb., *Salix koreensis* Anderss. and *Maackia amurensis* Rupr. & Maxim. Trees with the least distribution are *Cornus officinalis* S. & Z., and *Sophora japonica* L., which are spontaneous on a mountain slope about thirty miles northeast from Keijyo and are found wild nowhere else in Korea. The genus *Salix* is richest in species and some like *S. nobilis* Nakai, *S. cardiophylla* Trautv. & Mey. and *S. koreensis* Anderss. are large and handsome trees; *Betula* and *Acer* with nine species each come next, followed by *Quercus* and *Cornus* each with six species and *Ulmus* with five. The Birches, except the shrubby *Betula fruticosa* Pall. and *B. chinensis* Maxim. which is always a small tree, are handsome and grow to a good size. The most remarkable is *B. Schmidtii* Regel, which has hard, close-grained wood, heavier than water, and much exported to Manchuria and China for making axletrees and felloes of carts. This species grows on steep, rocky slopes and the trees though not tall have a short,

stout trunk, clothed with thick, dark bark which flakes off, and a broad crown of no particular shape made up of massive branches. Curiously, the wood and bark of the very different *B. chinensis* Maxim. is almost identical with that of *B. Schmidtii* Regel, but the tree is always small and is found in lower altitudes and on any kind of soil. On the Diamond Mts. I saw the best examples of *B. chinensis* Maxim. Of true Maples only *Acer pictum* Thunb. grows to any real size and this calls for no special comment. Another (*A. pseudo-sieboldianum* Kom.) makes a poor looking tree of medium size but is abundant and in autumn its foliage assumes wonderful tints of orange, scarlet, and crimson and is responsible for much of the autumn beauty of forest and wood. In open country and especially by riversides and in swamps *A. ginnala* Maxim. is abundant as bushes or low, shapeless trees. Its leaves have considerable economic value, being gathered in late summer and after sun drying packed in bales and exported to China where blue, black, and khaki color dyes are prepared from them. Of the eight Maples two are Negundos and both make strikingly handsome trees. The oldest known of the two is *A. mandshuricum* Maxim. which grows 80 ft. tall, has a shapely crown and a straight trunk clothed with firm, pale gray, slightly fissured bark. The other, *A. triflorum* Kom., is of much the same size, has thicker branches and a thin, papery gray-brown bark which shreds off. The autumn tints of both are yellow, orange, and salmon, and singularly beautiful. Of the Oaks *Q. mongolica* Fisch. is the best and its wood the most valuable and when the soil is good, as on Nemonrei in the Diamond Mts., makes a fine tree in habit and size resembling the White Oak (*Q. alba* L.) of eastern North America. As usually seen, however, in Korea the Mongolian Oak is not attractive, being of moderate size only and frequently stagheaded. The less abundant *Q. glandulifera* Bl. is usually a better looking tree, and in the autumn its ruddy tinted foliage renders it most conspicuous. Of the Cornels besides the well known *Cornus kousa* Buerg. and *C. controversa* Hemsl., both strikingly beautiful in summer when in full flower, the less known *C. coreana* Wanger. deserves mention if only on account of its bark which on adult trees is almost black, and deeply fissured into tiny squares like that of *Diospyros virginiana* L. The Korean Cornel grows 60 ft. high and has a trunk from 4 to 5 ft. in girth; the leaves are opposite, but the flowers and fruit are similar to those of *C. controversa* Hemsl. It is interesting to note that the old *C. officinalis* S. & Z., long known as a cultivated tree in Japan, is endemic in Korea where it is a tree often 35 ft. tall with a trunk from 4 to 5 ft. in girth and thin pale gray bark which scales off in loose papery sheets. The common Elm is *Ulmus japonica* Sarg. but nowhere did I see large trees of this species such as are common in Hokkaido; indeed, the largest Elm in Korea is *U. pumila* L. which in the valleys of the north is often 80 ft. tall and has a trunk as much as 12 ft. in girth.

Trees with conspicuous flowers and striking objects in the landscape are *Prunus mandschurica* Koehne, distinguished among Apricots by its large size and by its thick, corky black bark which is red beneath, a Cherry

(*Prunus serrulata* var. *pubescens* Wils.), Wild Pear (*Pyrus ussuriensis* Maxim.), Crab Apple (*Malus baccata* var. *mandshurica* Schneid.), Tree Lilac (*Syringa amurensis* Rupr.), *Maackia amurensis* Rupr. & Maxim. and *Aralia chinensis* L., *Acanthopanax ricinifolius* Seem. and the two Lindens *Tilia amurensis* Rupr. and *T. mandshurica* Rupr. & Maxim. The above trees all grow in plenty and when in flower their effect on the landscape can easily be imagined. The Pear in particular is noteworthy as being the most cold-resisting of Asiatic species and as growing to a larger size than any other—trees from 60 to 75 ft. with crowns as much in diameter and trunks from 10 to 14 ft. in girth are not uncommon. It is widespread in Korea and is frequently found in the forest depths though more usually by the side of streams and on the edge of the forest. The fruit, which is depressed-globose and from one third to half an inch in diameter, may be ruddy or green and with or without the remains of the calyx; the leaves, which vary in shape and serration, assume rich bronze and purple tints in autumn. Cultivated forms of this species are grown in gardens in Korea, Manchuria and north China and yield palatable fruit of good size. The Crab Apple is a tree of moderate size and its wealth of white blossoms in spring is followed by an abundance of small, greenish red to scarlet fruits. It loves a cool soil and is particularly happy in thickets on the banks of mountain streams.

As in other boreal floras conifers are abundant. Besides the Red Pine (*Pinus densiflora* S. & Z.), whose prominence has already been alluded to, the Korean Nut Pine (*P. koraiensis* S. & Z.) is a very common tree on the mountains, and the Creeping Pine (*P. pumila* Regel) clothes the upper slopes and summits of most of the higher peaks from Kangaku-san, about Lat. 38° 30' N., northward except that of Paiktu-san itself from which it is entirely absent. Two Firs (*Abies holophylla* Maxim. and *A. nephrolepis* Maxim.) are both plentiful, the first-named being indigenous and confined to the low-levels and the other the mountain species. A third species restricted to Quelpaert and Chiri-san has been referred to already. A flat-leaf Spruce (*Picea jezoënsis* Carr.) and another with four-angled leaves (*P. koyamai* Shiras.) grow in Korea. The latter is confined to the north and more especially the northeast but the flat-leaf species grows as far south as Chiri-san. An unnamed species of Thuja is common on high, non-volcanic mountains from the Diamond Mts. northward; in the forest it is a sturdy shrub or even a small tree often 30 ft. tall but on high treeless slopes it is an undergrowth to *Pinus pumila* Regel. One Juniper (*Juniperus rigida* S. & Z.) is very common, more especially in open country and thin woods of Red Pine or Oak; another (*J. communis* var. *montana* Ait.), grows only in the north, whilst a third (*J. chinensis* var. *Sargentii* Henry), is confined to rocky places high up on the mountains but is distributed from the extreme north to Quelpaert where it grows on Hallaisan at 1600 m. and upwards. To complete the list of conifers indigenous on the peninsula it remains to mention a Larch (*Larix dahurica* var. *Principis-Rupprechtii* Rehd. & Wils.) which covers much of the volcanic area

of the north and is not found elsewhere. This Larch with the two Spruces, the Nut Pine, and the Mountain Fir either grow together or form more or less pure forests and the wood of one and all is of good quality. The other Fir (*Abies holophylla* Maxim.) is of little value as a timber tree but for garden purposes it ranks with the Japanese *A. homolepis* S. & Z. as the best of the Asiatic species. The branches are moderately stout, spreading or ascending-spreading and crowded with dark green leaves. Trees 100 ft. tall with trunks 12 ft. in girth are not uncommon in fairly open country where the soil is rich and moist.

Of Taxaceae only *Cephalotaxus drupacea* S. & Z. and *Taxus cuspidata* S. & Z. grow on the mainland of Korea. The *Cephalotaxus* as a small shrub of no particular shape is scattered here and there from the vicinity of Keijyo, the capital, southward; the Yew is much more widely spread, growing as far north as the upper waters of the Yalu River. It is not a common tree, though on the Nemonrei, in the Diamond Mts., it is more plentiful and of greater size than I have seen it anywhere else in the Japanese empire.

At this point it seems opportune to say a little about the natural rotation of forests, or, the succession of forest growth as it may be termed — a subject little understood but clearly demonstrated in and by the virgin forests of north Korea. To appreciate this succession and to properly understand what follows, it is necessary to state that in the temperate regions of northeast Asia (and probably everywhere in the world) there are aggressive northern and southern types that are ever extending their geographical range at the expense of (a) types already in occupation of intervening regions, (b) those that flourish under peculiar conditions only, (c) themselves finally. Of these aggressive northern types in Korea may be mentioned Aspen (*Populus tremula* var. *Davidiana* Schneid.), Alder (*Alnus hirsuta* Turcz.), Birches (*Betula davurica* Pall., *B. Ermanii* Cham., *B. japonica* Sieb.), Creeping Pine (*Pinus pumila* Regel), Fir (*Abies nephrolepis* Maxim.), two Spruces (*Picea jezoënsis* Carr., *P. Koyamai* Shiras.). Of southern aggressive trees Red Pine (*Pinus densiflora* S. & Z.), Oaks (*Quercus mongolica* Fisch., *Q. dentata* Thunb., *Q. glandulifera* Bl.), Hornbeam (*Carpinus laxiflora* Bl., *C. cordata* Bl.), Ash (*Fraxinus rhyncophylla* Hance, *F. mandshurica* Rupr.) may be instanced; of types in possession, that is species endemic or nearly so, Fir (*Abies holophylla* Maxim.), Nut Pine (*Pinus koraiensis* S. & Z.) Birch (*Betula Schmidtii* Regel), Maple (*Acer pseudo-sieboldianum* Kom.), Box-elder (*Acer triflorum* Kom., *A. manshuricum* Maxim.), Wild Pear (*Pyrus ussuriensis* Maxim.), Apricot (*Prunus mandschurica* Koehne) may serve as examples.

After forest fires or deforestation by man Birch, usually *Betula davurica* Pall. or *B. Ermanii* Cham. less commonly *B. japonica* Sieb., is the first tree to appear in almost any part of Korea. In the south and at low altitudes and to a less degree in central Korea the Birch may be forestalled by coarse grasses (*Miscanthus* spp. and allies) and natural reforestation long retarded, but normally, Birch is soon joined by other broad-leafed deciduous trees and

frequently by Red Pine and Fir (*Abies holophylla* Maxim.) and in the course of time develops into pure broad-leaf forest, mixed forest or pure Pine-forest according to the type which becomes dominant. On the east side of the Diamond Mts. where man has much thinned the former pure forest of Red Pine, broad-leaf trees are rapidly changing the whole character of the forest. On the west side of the same mountains, especially round the monastery of Choanji, the broad-leaf forests are being displaced by Nut Pine and Fir. In central Korea and northward coarse grasses are less aggressive and Birch is associated with Aspen in increasing quantity until the volcanic areas of the Paiktu region are reached where Larch becomes a prominent companion of the Birch and Aspen. It is in this Paiktu-san region that the succession of forest types is most clearly shown. The cycle is roughly as follows: In the course of time after volcanic activity in that region had ceased, as after forest fires at the present time, seedlings of Birch, Aspen and Larch sprang up from seeds transported from the north by wind. Then, as now, the three kinds of trees grew well together for a few years, the Birch and Aspen the faster at the commencement, but the Larch, though it needs when young a certain amount of shade just such as the twiggy branches of Birch and Aspen afford, is a light-demanding tree and after twenty or thirty years it outstrips its fellows in pace of growth, finally kills them and pure forests of Larch remain. Such forests are thin, open and park-like in aspect and the trees almost of the same age, for no Larch seedlings will vegetate in such forests except by the side of well-tramped paths, or on fallen, rotting trunks, but where fire breaks through they thrive exceedingly. As the Larch-trees increase in size, so the forest floor beneath becomes more and more shady and invites the presence of more shade-loving trees such as Fir and Spruce. When the Larch is from sixty to one hundred years old seedlings of these Fir and Spruce establish themselves, in the course of time grow into trees and finally kill out the Larch to form pure forests of themselves. Like the Larch the trees are of about the same age, for in such forests seedlings do not vegetate under the dense shade of the parent trees either because the shade is too great, because there is too much humic acid in the soil from the constant accumulation of rotting vegetation, or, because of both. On the edges of these forests, in glades, or on fallen rotting trunks only are young seedlings of Spruce and Fir to be found.

Larch with its deciduous leaves, and trunks clear of branches for a considerable distance from the ground, is in much less danger from fire than Fir and Spruce which are evergreen, keep their branches from near the ground upward and, moreover, have a very resinous bark and resinous leaves. However, sooner or later, either from electrical storms or through human agency, fire sweeps through the forests and the cycle is repeated.

The Fir (*Abies holophylla* Maxim.) and the Nut Pine (*Pinus horaiensis* S. & Z.) nowhere in Korea, to-day, form pure forests. Both are associated with broad-leaf trees and the conifers mentioned above. They love rich, cool soils and in the extreme north of Korea there are limited areas of forest fifty per cent pure Nut Pine.

The Larch forests being of open character are easy to traverse and have quite a rich undergrowth of shrubs among which Birch (*Betula fruticosa* Pall.), Blueberry (*Vaccinium uliginosum* L.) and *Ledum palustre* L. in many forms are prominent. The Fir- and Spruce-forests are less rich in woody undergrowth and those of pure Red Pine have none at all. The broad-leaf forests on the other hand are rich in shrubs and climbers of an ornamental character, though those reach their greatest exuberance where trees are fewest. Most abundant are Azaleas, Roses, Magnolias, Honeysuckles, Lillacs, Mock Orange, Deutzia, Forsythia, Spiraea, Indigofera, Symplocos, Viburnum, Berberis, and the climbers Actinidia, Celastrus, Pueraria, Smilax, and Vitis, whilst in central and south Korea on boulders, cliffs, walls, ramparts, and trunks of forest trees the familiar "Ampelopsis Veitchii" (*Parthenocissus tricuspida* Planch.) luxuriates. In the rocky beds of summer torrents and on the banks of streams the Gray Willow (*Salix gracilistyla* Miq.) is superabundant. The tops of the higher mountains in north Korea are clothed with such alpine shrubs as Creeping Pine (*Pinus pumila* Regel), dwarf Junipers (*Juniperus chinensis* var. *Sargentii* Henry, *J. communis* var. *montana* Aiton), an unnamed Thuja, dwarf Willows in variety, Cowberry and other Vacciniums, the red fruited variety of Arctous (*Arctous alpinus* var. *ruber* Rehd. & Wils.), Crowberry, Dryas, and Rhododendrons such as *Rhododendron chrysanthum* Pall., *R. parvifolium* Adams and allied species. On the barest and most rocky hills and mountains slopes a few woody plants may be found. In spring, late May and early June according to latitude, the whole countryside is gaily decked with flowers. The Wild Pear, Crab Apple, Wild Cherry, Apricot, and other flowering trees which enliven the glades, edge of the forest, river bank, and open country must not be forgotten in this attempt to visualize Korea in spring, nor, the young unfolding leaves of the forest trees from the pure green of the Larch through the grays of some Oaks to the ruddy tints of other species of Oak and Maple. The undergrowth in the woods and the shrubberies when the trees have been destroyed are splashed with masses of white, yellow, pink, rose and purple. Not even in the richest parts of China or Japan have I seen such extensive displays of pure pink and white as on the Diamond Mts. where *Rhododendron Schlippenbachii* Maxim. and *Magnolia parviflora* S. & Z. dominate the undergrowth for many square miles and bloom to perfection.

On the bare hillsides and mountain slopes of central Korea — round Keijyo, the capital, for example — a Forsythia is plentiful and its yellow bells in spring are conspicuous. On the mudshales and limestone a little to the northwest of Keijyo grows a Lilac (*Syringa dilatata* Nakai) which opens its panicles of palest lilac tinted flowers early in spring. It is a bush of good habit often twelve feet high and nearly as much broad with dark green leathery foliage which colors finely in autumn. Examples two feet high bear flowers. In the woods and thickets grow two other species of Lilac and these produce their nearly white to ruddy purple flowers in early summer and the fragrance of one of them (*Syringa Palibiniana* Nakai) is

delightful. In early summer too a lovely Weigelia (*Diervilla florida* var. *venusta* Rehd.) and the Rose Indigofera (*Indigofera Kirilowii* Maxim.) are clothed with their attractive flowers and since the plants are plentiful the display is conspicuous. Very plentiful in open country and thin woods is that harbinger of spring *Rhododendron mucronulatum* Turcz. and so too is the less well-known *R. poukhanense* Lév. which with its compact, twiggy growth and wealth of fragrant, rosy-mauve colored flowers is a feature of the countryside in late April and May from Quelpaert northward to the latitude of Pingyang. On rocky, grass-clad slopes it covers areas which on the foothills of Chiri-san are acres in extent; on Quelpaert it grows in great plenty from sea-level to the summit of Hallai-san (alt. 1952 m.). The white-flowered Rambler Rose (*Rosa multiflora* Thunb.) and its more northern and handsomer relative *R. Jackii* Rehd., are also among the features of the early summer flora of Korea.

Since Pine and Fir are the dominant trees in the landscape over much of Korea the flowering shrubs and trees are well provided with a setting which enhances their beauty whether it be the flowers in spring and summer or the tinted foliage in autumn. Often in thin woods of Red Pine the undergrowth is almost entirely of pink, rose, or rosy-mauve Azaleas and the rose-colored Indigofera and such places are perfect gardens.

In species of climbing plants Korea is poor and it boasts no Wistaria nor anything approximating in beauty. However, climbing plants are plentiful if not varied, and in autumn the tints of Veitch's Ampelopsis and of the Amur Grape (*Vitis amurensis* Rupr.) are not exceeded in brilliancy anywhere. In early summer two Actinidias (*Actinidia kolomikta* Maxim., *A. polygama* Maxim.) with fragrant, white flowers in clusters hidden beneath the leaves, a great many of which are pure white or half white and half green, are striking objects on the mountain slopes. The white leaves change to pink and rose as the flowering period passes. In summer the most noteworthy climber is *Tripterogium Regelii* Sprague & Takeda, with its bright brown, lenticellate branches, large panicles of pure white flowers which are followed by white changing to pink, bladder-like fruits. It is abundant, sprawling over shrubs and small trees and sometimes over larger trees fifty feet and more tall.

Korea from early times has been the highway over which many Chinese plants of economic value and of ornamental character have travelled to Japan. For example: — Chinese Persimmon (*Diospyros kaki* L.), Sand Pear (*Pyrus serotina* var. *culta* Rehd.), Korean Apple (at present called *Malus asiatica* Nakai), Japanese Plum (*Prunus salicina* Lindl.), Bush-cherry (*P. tomentosa* Thunb.), Varnish Tree (*Rhus verniciflua* Stokes), Moutan Paeony (*Paeonia suffruticosa* Andrews), the Paulownia (*Paulownia tomentosa* K. Koch) and others, all indigenous in China, reached Japan by way of Korea. Likewise certain Korean plants were long ago introduced to Japan and reached Europe and America from there at a later date. Among older examples may be instanced *Pinus koraiensis* S. & Z., *Cornus officinalis* S. & Z., and *Diervilla florida* S. & Z.; in more recent times *Rhodo-*

dendron Schlippenbachii Maxim. and *Viburnum Carlesii* Hemsl. The last named, probably the best known and most popular of Korean shrubs, was introduced from Japan into England in 1902.

By roundabout ways plants from China have, intermittently, found their way to western lands from the 16th cent. if not earlier, and from Japan since the 17th cent., though in each case often with long breaks in the periods. Yet, the 20th cent. had almost dawned before any seeds or living plants direct from Korea reached the Occident. In 1897, a Russian Botanist, Vladimir L. Komarov, made a trip through north Korea, collected herbarium material and probably some seeds, for in the *Gardener's Chronicle* (ser. 3, XLIV, 210 [1908]), there is a figure, and note about *Rodgersia tabularis* Kom., a typical Korean herbaceous plant, flowering in Kew gardens from seeds received from the Imperial Botanic Garden, Petrograd, in 1905. In December, 1904, the Arnold Arboretum received, through the Imperial Botanic Gardens, Tokyo, some seeds collected in Korea by T. Uchiyama which resulted in the introduction of *Abies holophylla* Maxim. and *Hemiptelea Davidii* Planch. In 1905, Mr. J. G. Jack, of the Arnold Arboretum staff, was in the Orient and visited Korea. The Russo-Japanese war was still in progress and it was impossible for any one to travel freely in Korea. Moreover, Mr. Jack's main purpose was not botanical collecting, nevertheless he sent back to this institution seeds and living material of quite a number of plants which have proved to be of exceptional interest and value. To Mr. Jack we owe such Korean plants of merit and hardiness as *Rhododendron poukhanense* Lévl., *Diervilla florida* var. *venusta* Rehd., *Tripterygium Regelii* Sprague & Takeda, *Malus baccata* f. *Jackii* Rehd., *Rosa Jackii* Rehd., *Evodia Daniellii* Hemsl., an Oak (*Quercus aliena* Bl.) and the plants in this Arboretum of the lovely *Indigofera Kirilowii* Maxim. This list makes no pretense of being complete but their value was a sufficient incentive to further work in Korea and culminated in the Expedition, undertaken by the Arnold Arboretum, which lasted from 1917 to February, 1919. Among other things this expedition secured seeds and living plants of about two hundred species and varieties of woody plants. Of the behavior of these here it is too early to write and it would be unwise to enlarge upon their qualities. As they grow in Korea many are decidedly handsome and we may hope that they will successfully adapt themselves to the climates and soils of western lands.

Compared with the floras of China and of Japan that of Korea is a fairly simple study but it cannot be properly understood unless its relationship with that of contiguous and adjacent regions be given due consideration. It is not without its own peculiar problems and contains much of interest to the botanist and gardener.